mitigation, although some restoration of hydrology or enhancement opportunities also exist within the Corridor. For instance, the berms and excavations of the South Creek Water Management District have removed the floodplain functions of many of the parcels adjacent to South Creek. Exploration of hydrologic restoration through berm-breaching or other appropriate methods on suitable parcels, in order to reconnect portions of the Corridor to the flooding regime of South Creek, may provide different mitigation on some parcels. Site specific plantings on recently timbered pine plantation parcels may also provide enhancement credits.

7.0 LONG TERM MANAGEMENT AND ADAPTIVE MANAGEMENT

- 7.1 Long Term Management and Financial Assurances. According to RGL-05-1, detailed well-written special conditions and compliance requirements are usually sufficient to ensure functional success of mitigation without additional sureties or financial assurances. However, on a case by case basis, permits may be written that require financial assurances. Items that factor in to the Corps decision to require financial assurances may include among others, length of monitoring required, timing of mitigation, experience with permittee and/or consultant, and whether the project requires new technology or uses proven techniques. Financial assurances such as performance bonds, escrow accounts for mid-course corrections, or other components such as a schedule of project phases have not been required of PCS for past mitigation sites. However, legal or real estate instruments such as perpetual conservation easements once a site is deemed successful have been part of past permit conditions. Detailed plans prepared and approved for each PCS compensatory mitigation site will contain enough financial assurances to guarantee the basic integrity of the mitigation site during its development and for proper management after it has met permit conditions and success criteria.
- 7.2 <u>Adaptive Management.</u> Application of adaptive management principles to compensatory mitigation is included in the National Mitigation Action Plan, an interagency response to a widespread perception that Section 404 permitting and mitigation compliance has not upheld the goal of no net loss of wetlands. Adaptive management is an iterative process between the permittee and the regulatory agencies to establish clear goals and objectives, realistic and science-based success criteria, and a well-defined monitoring program. It is the proactive identification of potential risks to successful restoration of wetland functions and specification of the remediation activities to implement in order to reduce the risks or to increase the likelihood of success should such risks occur. Adaptive management principles entail the following steps: plan, act, monitor, evaluate, and adjust; however, the process does not necessarily imply perpetual maintenance. Consideration of potential responses to risks such as invasive species, structural failure, storms, offsite actions of third parties, and unexplained events would be part of every site specific detailed mitigation plan prepared by PCS.
- 7.3 Final Dispensation of Mitigation Sites. Perpetuity instruments and responsible parties for each successful mitigation site will be determined on a case-by-case basis over the course of the monitoring period, if not before. In some instances, responsible parties may be identified at the onset because of the particular attributes of a site (if site has long been on a wish list of the Nature Conservancy, for example). Public hunting would be a common end use for mitigation property, to compensate for lost hunting opportunities on mined land. The conservation easement for the Parker Farm wetland mitigation project is held by the North Carolina Wildlife Resources Commission (NCWRC), and has been placed in their Gamelands program. Because of other particular attributes of a site, such as invasive species or the need for controlled burning of a wet savanna, a maintenance plan might be necessary. However, PCS prefers that careful mitigation site selection and design would insure continued function beyond the success determination and would help to insure the need for minimal follow-up maintenance.

8.0 REFERENCES CONSULTED OR CITED

- Ainslie, W., and W.L. Kurczynski. 1989. Mitigation of BLH wetlands and the Section 404 permit program: EPA perspectives. P.1-18 in T.A. White, J.A. Allen, et al. (eds). Mitigation site type classification: A methodology to classify pre-project mitigation sites and develop performance standards for construction and restoration of forested wetlands: Results of an EPA-sponsored workshop. Performed for Region IV Wetlands Planning Unit. USEPA, Atlanta. 85 pp.
- Brinson, M.M. 1993. Changes in the functioning of wetlands along environmental gradients. Wetlands 13. 65-74.
- Bullock, Andy and Mike Acreman. 2003. The role of wetlands in the hydrological cycle. Hydrology & Earth System Sciences, 7(3), 358-389.
- Craft, Christopher, Stephen Broome, and Carlton Campbell. 2002. Fifteen years of vegetation and soil development after brackish-water marsh creation. Restoration Ecology. Volume 10 Issue 2. 248-258.
- Cowardin, L..W., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. US Fish and Wildlife Service. Washington, DC. FWS/OBS-79/31.
- Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Wetlands Research Program Technical Report Y-87-1. US Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS. 92 pp.
- Hall, K. 2003. Recommended native plant species for stream restoration in North Carolina. North Carolina Stream Restoration Institute, NC State University, Raleigh.
- Institute for Water Resources. 2002. Aquatic Resource News. Volume 1 Issue 2. Winter 2002. US Army Corps of Engineers.
- Institute for Water Resources. 2003. Aquatic Resource News. Volume 2 Issues 1, 2, and 3. Spring, Summer, and Fall. US Army Corps of Engineers.
- King, D.M., Wainger, L.A., Bartoldus, C.C., and Wakeley, J.S. 2000. Expanding wetland assessment procedures: Linking indices of wetland function with services and values. ERDC/EL TR-00-17, U.S. Army Engineer Research and Development Center, Vicksburg. MS.
- Lecce, S. A. 2000. Seasonality of flooding in North Carolina. Southeastern Geographer, XXXXI
- Martin, Steven, Robert Brumbaugh, and Palmer Hough. 2005. Conceptualizing mitigation performance standards. National Wetlands Newsletter. March-April.
- Miller, Kevin H. et al. 2003. Hydrology and water quality of coastal plain headwater streams: Effects of stream channel, riparian condition and land use. Wetland Restoration and Research Institute.
- Miller, Raymond E., Jr., and Boyd E. Gunsalus. 1999. Wetland rapid assessment procedure (WRAP). Technical Publication REG-001. Natural Resource Management Division, Regulation Department, South Florida Water Management District.
- Muotka, T. & Laasonen, P. 2002. Ecosystem recovery in restored headwater streams: the role of enhanced leaf retention. Journal of Applied Ecology, 39, 145-156.

- Natural Resources Conservation Service. 2001. Stream corridor inventory and assessment techniques. Watershed Science Institute Technical Report. US Department of Agriculture. (January revision).
- North Carolina Cooperative Extension Service. 2002. River course. Fact sheet series on use of natural channel design in restoration of impaired streams. 8/02-IM-JMG 120977-120980.
- North Carolina Department of Environment and Natural Resources, Division of Water Quality and Division of Land Resources. 2001. Internal guide for streamwork in North Carolina. Version 3.0, April.
- North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2004. Basinwide planning program: 2004 Tar-Pamlico River basinwide water quality plan.
- North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2005. Identification methods for the origins of intermittent and perennial streams, Version 3.1. Raleigh, NC.
- North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2006. North Carolina Water Quality assessment and impaired waters list (2006 integrated 305(b) and 303(d) report). Public review draft.
- North Carolina Ecosystem Enhancement Program. 2004. Tar-Pamlico River basin watershed restoration plan. April 2004.
- Novitski, R. P., et al. 1996. Wetland functions, values and assessment. National water summary on wetland resources. USGS water supply paper 2425.
- Palmer, M.A. et al. 2005. Standards for ecologically successful river restoration. Journal of Applied Ecology. 42, 208-217.
- Rheinhardt, R.D. et al. 1999. Application of reference data for assessing and restoring headwater ecosystems. Restoration Ecology. 7, 241-251.
- Rheinhardt, Richard et al. 2006. Development of a reference based method for identifying and scoring indicators of condition for coastal plain riparian reaches. Ecological Indicators. In press.
- Rosgen, D.I. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.
- Schafele, Michael P., and Alan. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation. NC Department of Environment, Health, and Natural Resources.
- Somerville, D. E. and B.A. Pruitt. 2004. Physical stream assessment. A review of selected protocols for use in the Clean Water Act Section 404 program. September, 2004. Prepared for USEPA Office of Wetlands, Oceans, and Watersheds, Wetlands Division (Order No. 3W-05-3-NATX). Washington DC. 213pp.
- Stanturf, John. A, et al. 2001. Achieving restoration success: myths in bottomland hardwood forests. Restoration Ecology. Vol. 9. No. 2. 189-200.
- Stillwater Sciences. 2001. Abstracted/annotated bibliography: hydrology and hydrologic regimes in headwater streams. NCASI Headwater Streams Project, Preliminary Draft-March 2001.

- US Army Corps of Engineers and Environmental Protection Agency. 1990. Memorandum of agreement between the Environmental Protection Agency and the Department of the Army concerning the determination of mitigation under the Clean Water Act Sectoin 404(b)(1) Guidelines.
- US Army Corps of Engineers. 1996. Final environmental impact statement for the Texasgulf, Inc. mine continuation, Aurora, North Carolina.
- US Army Corps of Engineers, Wilmington District et al. 2003. Stream mitigation guidelines. April. 26 pp.
- USDA Part 614.4. NRCS. 1999. Conservation corridor planning at the landscape level: *managing for wildlife habitat*. Part 190. National Biology Handbook. NRCS Watershed Sciences Institute and Wildlife Habitat Institute.
- USDA. Natural Resources Conservation Service. 2001. Stream corridor inventory and assessment techniques. Watershed Science Institute Report. January revision.
- US Environmental Protection Agency. 1992. Region IV draft mitigation banking guidance.
- US Environmental Protection Agency. 1998. Wetland biological assessments and HGM functional assessment. Office of Water, Wetlands, Oceans and Watersheds (4502-F). EPA843-F-98-001f. July.
- US Environmental Protection Agency. 2001 Compensatory mitigation policy. Wetlands Section, Water Management Division, Region IV.
- Watershed Science Institute Technical Report. 1999. Assessing conditions of riparian-wetland corridors at the area wide level. September. US Department of Agriculture.